Maximum Permissible Exposure (MPE) Estimation for F285/ PCDF285DPC

1 Introduction

HUAWEI F285/ PCDF285DPC is a CDMA Fixed Wireless Terminal. It's operated in Band Class 0, Band Class 1 and Band Class 10.It also used as a cordless phone in the DECT system. The TX is 824MHz-849MHz, the RX is 869MHz-894MHz for Band Class 0; the TX is 1850MHz-1910MHz, the RX is 1930MHz-1990MHz for Band Class 1; the TX is 816MHz-824MHz, the RX is 861MHz-869MHz for Band Class 10. It supports A-GPS service and CDMA2000 1X advanced. Externally it provides USB interface (USB Type A port for test purposes), antenna interface, and power interface. Externally it provides and SIM card interface and Ear phone port for TTY function.

2 Limits and Guidelines on Exposure to Electromagnetic Fields

According to the FCC Part 2.1091, we know: mobile device (transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 centimeters is normally maintained between the transmitters radiating structure(s) and the body of the user or nearby persons). And the Cellular radiotelephone service and PCS services are subject to routine environmental evaluation for RF exposure prior to equipment authorization or use if they operate at frequencies of 1.5 GHz or below and their effective radiated power (ERP) is 1.5 watts or more, or if they operate at frequencies above 1.5 GHz and their ERP is 3 watts or more. The radiated power of 800MHz for F285/ PCDF285DPC is 1W, so the F285/ PCDF285DPC is excluded from routine environmental evaluation for RF exposure according to the requirement of FCC Part 2.1091. The present document is given just only for reference.

Uncontrolled limits are used for general public. General population/uncontrolled exposure apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure. The exposure levels can be expressed in terms of power density, electric field strength, or magnetic field strength, as averaged over 30 minutes for the general public and 6 minutes for trained personnel. The exposure criterion is frequency dependent, and a chart covering the range

from 3 kHz to 100 GHz can be found in NCRP No.86 (references IEEE C95.1-1999). Below are the limits.

For CDMA BC0

Limits for Occupational/Controlled Exposure			
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm2)**
0.3-3.0 **3.0-30** **30-300** **300-1500** **15,00-100,000**	**614** **1842/f** **61.4** **--** **--**	**16.3/f** **16.3/f** **0.163** **--** **--**	**(100)*** **(900/f2)*** **1.0** **f/300** **5**

Limits for General Population/Uncontrolled Exposure			
Frequency Range (MHz)	**Electric Field Strength (E) (V/m)**	**Magnetic Field Strength (H) (A/m)**	**Power Density (S) (mW/cm2)**
0.3-1.34 **1.34-30** **30-300** **300-15,00** **15,00-100,000**	**614** **824/f** **27.5** **--** **--**	**1.63** **2.19/f** **0.073** **--** **--**	**(100)*** **(180/f2)*** **0.2** **f/1500** **1.0**

Power density S [mW/cm2] for controlled area at 800 MHz

$$S = \frac{f(MHz)}{300} = \frac{824}{300} = 2.75 \text{ mW/cm}^2$$

Power density S [mW/cm2] for uncontrolled area at 800 MHz

$$S = \frac{f(MHz)}{1500} = \frac{824}{1500} = 0.549 \text{ mW/cm}^2$$

S= 0.549 mW/cm^2= 5.49 W/m^2 for uncontrolled exposure

For CDMA 1900M

Power density S [mW/cm2] for controlled area at 1900 MHz

S=5mW/cm^2

Power density S [mW/cm2] for uncontrolled area at 1900 MHz

S=1.0mW/cm^2

S= 1.0 mW/cm^2= 10 W/m^2 for uncontrolled exposure

For CDMA BC10

Power density S [mW/cm2] for controlled area at 800 MHz

$$S = \frac{f(MHz)}{300} = \frac{816}{300} = 2.72 \text{ mW/cm}^2$$

Power density S [mW/cm2] for uncontrolled area at 800 MHz

$$S = \frac{f(MHz)}{1500} = \frac{816}{1500} = 0.544 \text{ mW/cm}^2$$

S= 0.544 mW/cm^2= 5.44 W/m^2 for uncontrolled exposure

For DECT 2.4G

Power density S [mW/cm2] for controlled area at 2400 MHz

S=5mW/cm^2

Power density S [mW/cm2] for uncontrolled area at 2400 MHz

S=1.0mW/cm^2

S= 1.0 mW/cm^2= 10 W/m^2 for uncontrolled exposure

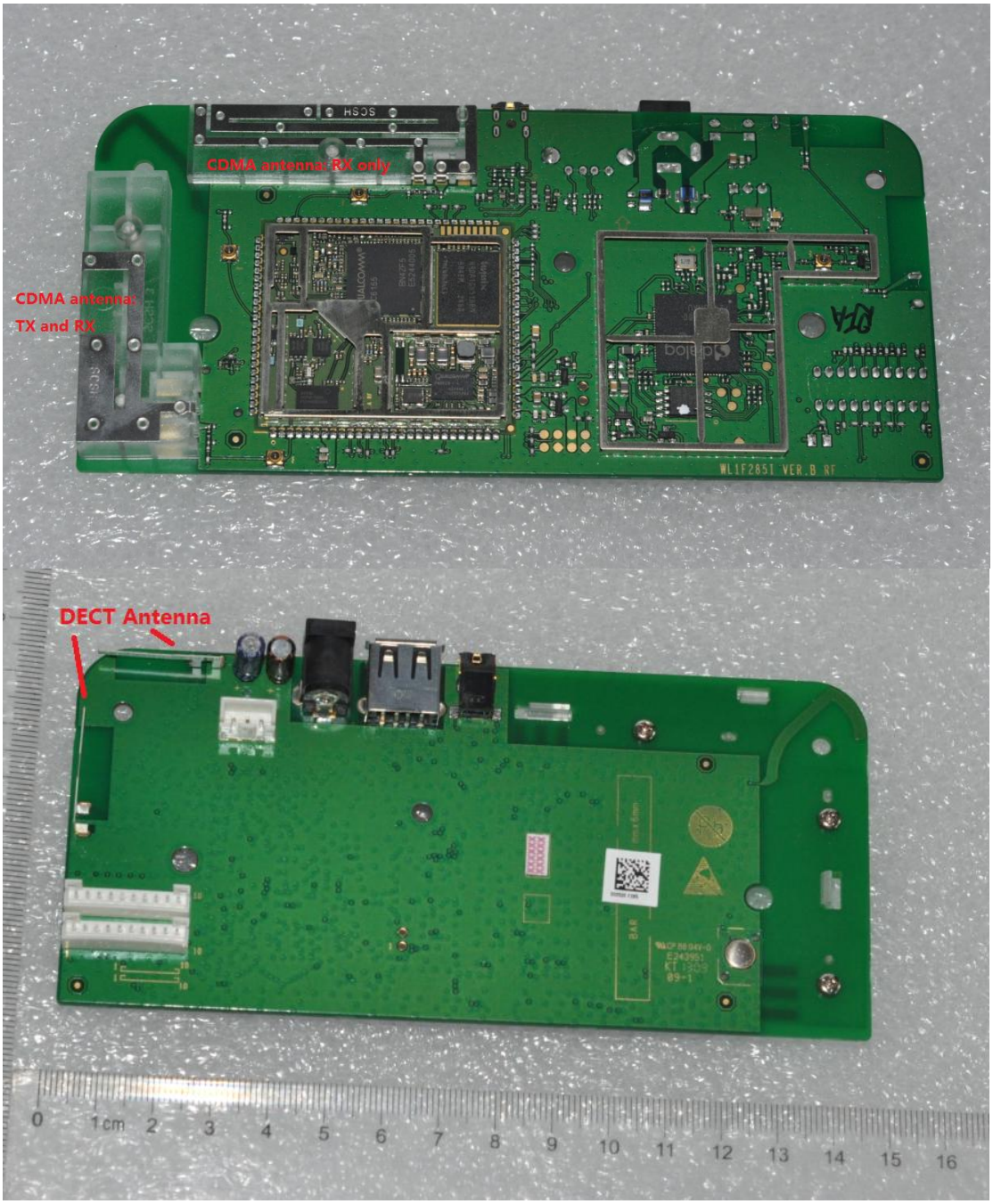
Reference levels are provided for exposure assessment to determine whether the basic restrictions on exposure of humans to electromagnetic fields are exceeded. The basic restrictions on exposure to electromagnetic fields are based directly on established health effects and biological considerations.

We can get the max ERP in channel 1013 from the RF report, the ERP is 25.61dBm, and the max EIRP in channel 25 from the RF report, the EIRP is 25.61dBm, which is less than 30dBm, so in this report we calculate by using the 30dBm as the worst case.

3 Location of EUT

The EUT uses one built-in antenna. The source of the radiation is mounted on terminal; generally the direction of the antenna position is uprightness tabletop. The highest level of

emission would be expected in close vicinity of the antenna and in line of sight to the antenna.



4 Prediction of the Exposure to Electromagnetic Fields

Calculations can be made on a site by site basis to ensure the power density is below the limits given above, or guidelines can be done beforehand to ensure the minimum distances

from the antenna is maintained through the site planning. The calculations are based on FCC OET 65 Appendix B.

4.1 Calculation of the Safe Distance

Below method describes a theoretical approach to calculate possible exposure to electromagnetic radiation around a base station transceiver antenna. Precise statements are basically only possible either with measurements or complex calculations considering the complexity of the environment (e.g. soil conditions, near buildings and other obstacles) which causes reflections, scattering of electromagnetic fields.

The maximum output power (given in EIRP) of a base station is usually limited by license conditions of the network operator.

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation. The calculations are based on FCC OET 65 Appendix B.

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

Whereas:

P = Maximum output power in W of the site

G numeric = Numeric gain of the antenna relative to isotropic antenna

R = distance between the antenna and the point of exposure in meters

4.2 Technical Description F285/ PCDF285DPC

For CDMA800M

Technical Specification:

Output power:	1W (30dBm) for CDMA800MHz
Transmitter frequency band	CDMA800
Number of antenna ports:	1
Frequency range:	800M： Uplink:816 M~849M； Downlink:861 M~894M
Gain:	1dBi

Mechanical specification (Height)	94 mm

For CDMA1900M

Technical Specification:

Output power:	1W (30dBm) for CDMA1900MHz
Transmitter frequency band	CDMA1900
Number of antenna ports:	1
Frequency range:	1900M： Uplink: 1850~1910MHz； Downlink: 1930~1990 MHz
Gain:	1dBi
Mechanical specification (Height)	94 mm

For DECT 2.4G

Technical Specification:

Output power:	0.25W (24dBm) for DECT 2.4G
Transmitter frequency band	DECT 2.4G
Number of antenna ports:	2
Frequency range:	DECT 2.4G： Uplink: 2400~2483.5MHz； Downlink: 2400~2483.5MHz
Gain:	1dBi
Mechanical specification (Height)	94 mm

4.3 Estimation of compliance boundary for indoor antenna

CDMA BC0:

For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary should be rather more conservative and on the safe side. For EUT the following compliance boundary is calculated:

Power at antenna connector BTS: **30 dBm**

Antenna-cable attenuation: **0 dB**

Input power to antenna: **30 dBm (1W)**

Antenna gain: **1dBi (1.26)**

Compliance boundary

For CDMA 800MHz band:

When r=20cm

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

$$S = \frac{1 * 1.26}{4 * 0.2^2 * \pi} = 2.5 W/m^2 < 5.49\ W/m^2$$

CDMA BC10:

For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary should be rather more conservative and on the safe side.

For EUT the following compliance boundary is calculated:

Power at antenna connector BTS: **30 dBm**

Antenna-cable attenuation: **0 dB**

Input power to antenna: **30 dBm (1W)**

Antenna gain: **1dBi (1.26)**

Compliance boundary

For CDMA 800MHz band:

When r=20cm

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

$$S = \frac{1 * 1.26}{4 * 0.2^2 * \pi} = 2.5 W/m^2 < 5.44\ W/m^2$$

CDMA 1900:

For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary should be rather more conservative and on the safe side.
For EUT the following compliance boundary is calculated:
Power at antenna connector BTS: **30 dBm**
Antenna-cable attenuation: **0 dB**
Input power to antenna: **30 dBm (1W)**
Antenna gain: **1dBi (1.26)**

Compliance boundary

For CDMA 1900MHz band:

When r=20cm

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

$$S = \frac{1 * 1.26}{4 * 0.2^2 * \pi} = 2.5 \text{W/m}^2 < 10 \text{ W/m}^2$$

DECT 2.4G Antenna 0:

For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary should be rather more conservative and on the safe side.
For EUT the following compliance boundary is calculated:
Power at antenna connector BTS: **24 dBm**
Antenna-cable attenuation: **0 dB**
Input power to antenna: **24 dBm (0.25W)**
Antenna gain: **1dBi (1.26)**

Compliance boundary

For DECT 2.4G band:

When r=20cm

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

$$S = \frac{0.25 * 1.26}{4 * 0.2^2 * \pi} = 0.63 \text{W/m}^2 < 10 \text{ W/m}^2$$

DECT 2.4G Antenna 1:

For the final determination of the compliance boundary the model for far-field calculation is used since this overestimates the field strength in the near-field region. Thus the calculated compliance boundary should be rather more conservative and on the safe side.

For EUT the following compliance boundary is calculated:

Power at antenna connector BTS: **24 dBm**

Antenna-cable attenuation: **0 dB**

Input power to antenna: **24 dBm (0.25W)**

Antenna gain: **1dBi (1.26)**

Compliance boundary

For DECT 2.4G band:

When r=20cm

$$S = \frac{P(W) * G_{numeric}}{4 * r^2(m) * \pi}$$

$$S = \frac{0.25 * 1.26}{4 * 0.2^2 * \pi} = 0.63 \text{W/m}^2 < 10 \text{ W/m}^2$$

DECT 2.4 G Antennas 0 and Antenna 1:

When r=20cm

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leqslant 1$$

$$\sum_{1}^{n} \frac{Si}{MPEi} = \frac{0.63}{10} + \frac{0.63}{10} = 0.126 < 1$$

CDMA BC0 and DECT 2.4 G Antennas 0 (or Antenna 1):

When r=20cm

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leqslant 1$$

$$\sum_{1}^{n} \frac{Si}{MPEi} = \frac{2.5}{5.49} + \frac{0.63}{10} + = 0.518 < 1$$

CDMA BC0 and DECT 2.4 G Antennas 0 and Antenna 1:

When r=20cm

$$\sum_{i=1}^{n}\frac{S_i}{MPE_i}\leqslant 1$$

$$\sum_{1}^{n}\frac{Si}{MPEi}=\frac{2.5}{5.49}+\frac{0.63}{10}+\frac{0.63}{10}=0.581\ <1$$

CDMA BC10 and DECT 2.4 G Antennas 0 (or Antenna 1):

When r=20cm

$$\sum_{i=1}^{n}\frac{S_i}{MPE_i}\leqslant 1$$

$$\sum_{1}^{n}\frac{Si}{MPEi}=\frac{2.5}{5.44}+\frac{0.63}{10}+=0.522\ <1$$

CDMA BC10 and DECT 2.4 G Antennas 0 and Antenna 1:

When r=20cm

$$\sum_{i=1}^{n}\frac{S_i}{MPE_i}\leqslant 1$$

$$\sum_{1}^{n}\frac{Si}{MPEi}=\frac{2.5}{5.44}+\frac{0.63}{10}+\frac{0.63}{10}=0.586\ <1$$

CDMA 1900 and DECT 2.4 G Antennas 0 (or Antenna 1):

When r=20cm

$$\sum_{i=1}^{n}\frac{S_i}{MPE_i}\leqslant 1$$

$$\sum_{1}^{n}\frac{Si}{MPEi}=\frac{2.5}{10}+\frac{0.63}{10}=0.314\ <1$$

CDMA 1900 and DECT 2.4 G Antennas 0 and Antenna 1:

When r=20cm

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leqslant 1$$

$$\sum_{1}^{n} \frac{Si}{MPEi} = \frac{2.5}{10} + \frac{0.63}{10} + \frac{0.63}{10} = 0.376 \ < 1$$

The S at the position which is 20cm far from the EUT is smaller than the uncontrolled exposure limit line. So the EUT also complies with the Limits for General Population/Uncontrolled Exposure.